

# Ion Thruster Power Levels Extended by a Factor of 10

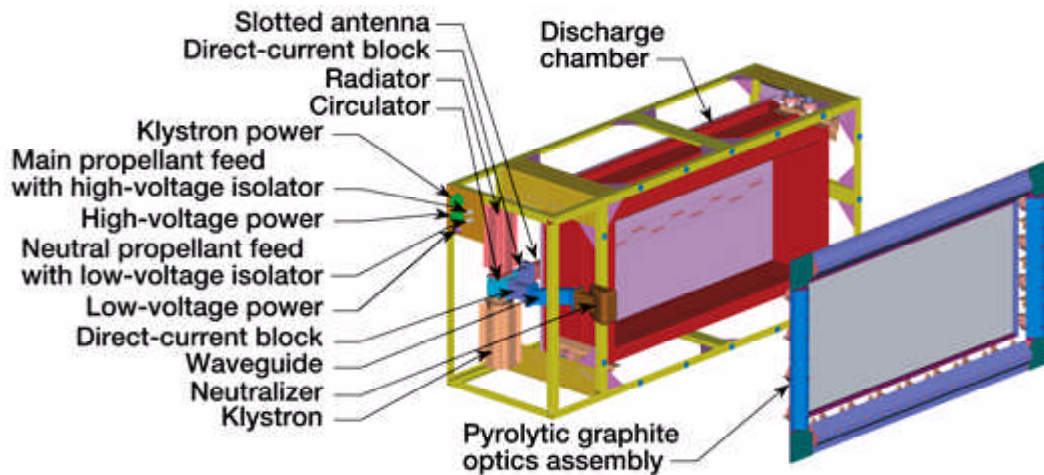


*Integration of an engineering model ion thruster in a Glenn test bed prior to wear testing.*

In response to two NASA Office of Space Science initiatives, the NASA Glenn Research Center is now developing a 7-kW-class xenon ion thruster system for near-term solar-powered spacecraft and a 25-kW ion engine for nuclear-electric spacecraft. The 7-kW ion thruster and power processor can be throttled down to 1 kW and are applicable to 25-kW flagship missions to the outer planets, asteroids, and comets. This propulsion system was scaled up from the 2.5-kW ion thruster and power processor that was developed successfully by Glenn, Boeing, the Jet Propulsion Laboratory (JPL), and Spectrum Astro for the Deep Space 1 spacecraft. The 7-kW ion thruster system is being developed under NASA's Evolutionary Xenon Thruster (NEXT) project, which includes partners from JPL, Aerojet, Boeing, the University of Michigan, and Colorado State University.

Engineering model thrusters have been built along with a breadboard power processor, a single-string xenon feed system, and a controller. Recently, a single-string system of this hardware was tested successfully at a Glenn test-bed facility that includes a suite of ion current probes, charge-state analyzers, and plasma potential diagnostics. In another

vacuum facility at Glenn, an engineering model thruster completed more than 1500 hr of a scheduled 2000-hr wear test. Posttest analyses of the 7-kW thruster will be performed prior to the construction of a prototype thruster capable of not only delivering the required performance and lifetime but also satisfying all environmental and multistring system-level test requirements. In addition, the power processor and xenon feed system will be upgraded to operate in the desired vibration and thermal-vacuum environments. This system is scheduled to be flight-ready by 2006.



*Xenon plasma generated by microwaves in a large, rectangular ion thruster instrumented with plasma probes.*

Diagram showing slotted antenna, direct-current block, radiator, circulator, klystron power, main propellant feed with high-voltage isolator, high-voltage power, neutral propellant feed with low-voltage isolator, low-voltage power, direct-current block, waveguide, neutralizer, klystron, discharge chamber, and pyrolytic graphite optics assembly.

Glenn's 25-kW ion-thruster development project, High Power Electric Propulsion (HiPEP), features a 41- by 91-cm rectangular ion thruster that employs a microwave discharge for plasma generation and ion beam neutralization with carbon-based ion-extraction grids. This is the largest inert gas ion thruster ever developed. Glenn's partners in the HiPEP development effort include Aerojet, Boeing, the University of Michigan, Colorado State University, and the University of Wisconsin. Eventually, this type of ion thruster along with power-conversion systems and a nuclear reactor will be part of a spacecraft dedicated to demanding missions such as a Jupiter grand tour, a Pluto orbiter, or a Jupiter icy moon orbiter. A vacuum facility test bed for the large, rectangular thruster has been built up, and uniform plasmas have been generated using a slotted-antenna microwave discharge. Software models have been exercised to determine the design of the ion-extraction grids, grid system performance, expected wear rates, and life-time estimates. In addition, preliminary power processor design studies have been completed based on an alternating current power bus at about 500 V and ~1.5 kHz. A breadboard of the 25-kW-class power processor is planned to be built and tested in 2004. A 25-kW ion thruster, power processor, and xenon feed system is planned to be ready for advanced

flight development in 2006.

**Find out more about this research:** <http://www.grc.nasa.gov/WWW/ion/>

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**Programs/Projects:** NEXT, HiPEP, JIMO, Project Prometheus

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